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NASA TECHNICAL MEMORANDUM

NASA TM X-64953

PROCEDURE FOR LOCATING 10 km UTM GRID ON ALABAMA COUNTY GENERAL HIGHWAY MAPS

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August 7, 1975

NASA



*George C. Marshall Space Flight Center
Marshall Space Flight Center, Alabama*

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HIGHWAY MAPS (NASA) 22 p HC \$3.25 CSCL 08B

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| 16. ABSTRACT Each county highway map has a geographic grid of degrees and tens of minutes in both longitude and latitude in the margins and within the map as intersection crosses. These will be used to locate the Universal Transverse Mercator (UTM) grid at 10 km intervals. Since the maps used may have stretched or shrunk in height and/or width, interpolation should be done between the 10 min intersections when possible. A table of UTM coordinates of 10 min intersections is required and is included as Appendix A. In Alabama, all eastings are referred to a false easting of 500 000 m at 87°W longitude (Central Meridian, CM). | | | |
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TECHNICAL MEMORANDUM X- 64953

PROCEDURE FOR LOCATING 10 km UTM GRID ON
ALABAMA COUNTY GENERAL HIGHWAY MAPS

Each county highway map has a geographic grid of degrees and tens of minutes in both longitude and latitude in the margins and within the map as intersection crosses. These will be used to locate the Universal Transverse Mercator (UTM) grid at 10 km intervals. Since the maps used may have stretched or shrunk in height and/or width, interpolation should be done between the 10 min intersections when possible. A table of UTM coordinates of 10 min intersections is required and is included as Appendix A. In Alabama, all eastings are referred to a false easting of 500 000 m at 87°W longitude (Central Meridian, CM). Material for this table was supplied by the Department of the Interior.

The interpolation procedure is best described by use of an example. The Macon County map of 1967 is chosen (Surveying and Mapping Division, 1967). The southernmost latitude defined on this map is 32°20'. The easternmost longitude defined is 85°40'. Examination of the map will reveal a small cross at the intersections of these coordinates. Other crosses occur at other intersections at 10' intervals. A light, sharp pencil line should be drawn connecting these crosses along the line of 32°20' latitude. The eastings of the two crosses are read from the table in Appendix A: at 32°20', the easting for 1°20' (the distance 85°40' is east of 87°0') is 625 490.29 m and the easting for 1°30' (the distance 85°30' is east of 87°0') is 641 178.03 m. The two crosses are therefore 15 687.74 m apart (641 178.03 minus 625 490.29). Careful measurement directly on the map shows that the physical distance between the crosses on the sample available is 24.74 cm. This measurement should be repeated for the specific map to be marked because the sample used in this example was old paper. The locations of exact 10 km marks on the 32°20' latitude line are determined by interpolation: for the 630 000 line,

$$\left(\frac{630\,000.00 - 625\,490.29}{15\,687.74} \right) 24.74 \text{ cm} = \left(\frac{4509.71}{15\,687.74} \right) 24.74 \text{ cm} = 7.11 \text{ cm}$$

east of the 85°40' cross; for the 640 000 line,

$$\left(\frac{640\,000.00 - 625\,490.29}{15\,687.74} \right) 24.74 \text{ cm} = \left(\frac{14\,509.71}{15\,687.74} \right) 24.74 \text{ cm} = 22.88 \text{ cm}$$

east of the 85°40' cross. A sharp pencil should be used to put temporary tick marks on the 32°20' latitude line measured eastward from the 85°40' longitude cross at 7.11 cm and 22.88 cm.

At this point it is interesting to note that these marks are 0.1577 m apart. Since they correspond to a real distance of 10 000 m, a scale of 63 412 is indicated for the particular paper copy of the map chosen. This represents a shrinkage of almost 0.1 percent. Continuing to the west, interpolations are made between the crossmarks for 85°50' (easting from Appendix A of 609 803.00 m) and 85°40' (easting of 625 490.24 m) for the 610 000 and 620 000 grid marks, and between 86°00' (easting of 594 116.11 m) and 85°50' for the 600 000 grid mark.

The northernmost latitude defined on the Macon County map is 32°30'. A series of interpolations is made along the 32°30' latitude line, and light pencil ticks are placed at the 600 000, 610 000, 620 000, 630 000, and 640 000 grid positions.

An accurate straight edge and a fine tip pen with india ink can now be used to connect the pencil ticks (and extension to the margins) for the five vertical lines. A pen size of "000", or approximately 0.1 mm, of the Koh-i-noor, Staedter Mars, or similar type is recommended. The pen should be compatible with the ink and the ink should be compatible with the map material.

The northings must be determined next. These should be marked in pencil along the easternmost and westernmost meridians defined on the map; in the case of the Macon County map these meridians are 85°30' and 86°00'. Since the Macon County map has only two lines of latitude defined (32°20' and 32°30'), these must be used for all northing interpolations. From Appendix A, the northings for the intersections are:

32°20', 85°30' (1°30' E of Central Meridian) 3 578 183.69

32°30', 85°30' (1°30' E of Central Meridian) 3 596 660.77

32°30', 86°00' (1°00' E of Central Meridian) 3 596 110.18

32°20', 86°00' (1°00' E of Central Meridian) 3 577 634.60

As before, careful measurements on the specific map to be marked should be made between the crossmarks — this time in the north-south direction. Locations of the UTM grid ticks for 3 570 000, 3 580 000, 3 590 000, and 3 600 000 lines should be placed on the easternmost (85°30') and westernmost (86°00') meridians. The tick marks should then be connected with inked lines extending to the margins.

The resulting 10 km grid should be labeled in all four margins. It is customary to deemphasize some of the digits by use of smaller case numerals. The eastings in this example would be labeled 600^{000m} E, 610^{000m} E, etc., and the northings would be 3570^{000m} N, 3580^{000m} N, etc. The symbol "m" for meters should be included to avoid confusion with the 30 000 ft state coordinate system.

This procedure has been written for the specific case of Alabama's General County Highway Maps. It could probably be adapted to other states and other maps. A brief description of the UTM system is given in Appendix B.

APPENDIX A

UTM COORDINATES FOR 10min INTERSECTIONS

For Latitudes 30.0 to 35°
Clarke 1866 Spheroid (m)
Coordinates for 10.0 min Intersections

| Delta Long. | E(West of CM) | E(East of CM) | Northing |
|-------------|---------------|---------------|------------|
| Latitude | | | |
| 30 .0 | | | |
| | 500000.00 | 500000.00 | 3318605.33 |
| .0 | 483925.05 | 516074.95 | 3318617.02 |
| 10.0 | 467850.03 | 532149.97 | 3318652.09 |
| 20.0 | 451774.88 | 548225.12 | 3318710.54 |
| 30.0 | 435699.51 | 564300.49 | 3318792.37 |
| 40.0 | 419623.88 | 580376.12 | 3318897.58 |
| 50.0 | 403547.90 | 596452.10 | 3319026.17 |
| 1 .0 | 387471.51 | 612528.49 | 3319178.14 |
| 1 10.0 | 371394.64 | 628605.36 | 3319353.49 |
| 1 20.0 | 355317.23 | 644682.77 | 3319552.22 |
| 1 30.0 | 339239.19 | 660760.81 | 3319774.33 |
| 1 40.0 | 323160.47 | 676839.53 | 3320019.82 |
| 1 50.0 | 307081.00 | 692919.00 | 3320288.69 |
| 2 .0 | 291000.70 | 708999.30 | 3320580.94 |
| 2 10.0 | 274919.52 | 725080.48 | 3320896.57 |
| 2 20.0 | 258837.37 | 741162.63 | 3321235.58 |
| 2 30.0 | 242754.20 | 757245.80 | 3321597.97 |
| 2 40.0 | 226669.93 | 773330.07 | 3321983.74 |
| 2 50.0 | 210584.50 | 789415.50 | 3322392.90 |
| 3 .0 | | | |
| 30 10.0 | | | |
| | 500000.00 | 500000.00 | 3337072.91 |
| .0 | 483951.98 | 516048.02 | 3337084.64 |
| 10.0 | 467903.89 | 532096.11 | 3337119.83 |
| 20.0 | 451855.66 | 548144.34 | 3337178.48 |
| 30.0 | 435807.23 | 564192.77 | 3337269.58 |
| 40.0 | 419758.53 | 580241.47 | 3337366.14 |
| 50.0 | 403709.50 | 596290.50 | 3337495.17 |
| 1 .0 | 387660.05 | 612339.95 | 3337647.65 |
| 1 10.0 | 371610.13 | 628389.87 | 3337823.58 |
| 1 20.0 | 355559.67 | 644440.33 | 3338022.98 |
| 1 30.0 | 339508.60 | 660491.40 | 3338245.83 |
| 1 40.0 | 323456.86 | 676543.14 | 3338492.15 |
| 1 50.0 | 307404.36 | 692595.64 | 3338761.92 |
| 2 .0 | 291351.06 | 708648.94 | 3339055.15 |
| 2 10.0 | 275296.87 | 724703.13 | 3339371.84 |
| 2 20.0 | 259241.74 | 740758.26 | 3339711.98 |
| 2 30.0 | 243185.59 | 756814.41 | 3340075.59 |
| 2 40.0 | 227128.36 | 772871.64 | 3340462.65 |
| 2 50.0 | 211069.98 | 788930.02 | 3340873.18 |
| 3 .0 | | | |

| Delta Long. | | E(West of CM) | E(East of CM) | Northring |
|-------------|------|---------------|---------------|-------------|
| | | Latitude | | |
| | | 30 | 20.0 | |
| | .0 | 500000.00 | 500000.00 | 3355547.98 |
| | 10.0 | 483379.04 | 516320.36 | 3355552.75 |
| | 20.0 | 467958.02 | 532041.98 | 3355558.05 |
| | 30.0 | 451936.86 | 548063.14 | 3355564.89 |
| | 40.0 | 435915.59 | 564084.59 | 3355572.27 |
| | 50.0 | 419893.87 | 580106.13 | 33555835.18 |
| 1 | .0 | 403871.91 | 596123.09 | 33555964.63 |
| 1 | 10.0 | 387849.54 | 612150.46 | 33556117.61 |
| 1 | 20.0 | 371826.71 | 628173.29 | 33556224.13 |
| 1 | 30.0 | 355803.34 | 644196.86 | 33556404.18 |
| 1 | 40.0 | 339779.37 | 660220.63 | 33556717.77 |
| 1 | 50.0 | 323754.73 | 676245.27 | 33556964.90 |
| 2 | .0 | 307729.36 | 692270.64 | 33557235.57 |
| 2 | 10.0 | 291703.13 | 708296.82 | 33557529.76 |
| 2 | 20.0 | 275676.13 | 724323.87 | 33557847.50 |
| 2 | 30.0 | 259648.15 | 740351.85 | 33558188.77 |
| 2 | 40.0 | 243619.16 | 756380.84 | 33558553.58 |
| 2 | 50.0 | 227592.19 | 772410.90 | 33558941.92 |
| 3 | .0 | 211557.90 | 788442.19 | 33559353.80 |
| | | 30 | 30.0 | |
| | .0 | 500000.00 | 500000.00 | 3374000.52 |
| | 10.0 | 484006.24 | 515993.76 | 3374021.32 |
| | 20.0 | 468012.41 | 531987.59 | 3374056.74 |
| | 30.0 | 452018.46 | 547981.54 | 3374115.78 |
| | 40.0 | 436024.30 | 563975.70 | 3374196.42 |
| | 50.0 | 420029.08 | 579970.12 | 3374304.68 |
| 1 | .0 | 404035.13 | 595964.87 | 3374434.55 |
| 1 | 10.0 | 388039.98 | 611960.02 | 3374588.03 |
| 1 | 20.0 | 372044.37 | 627955.63 | 3374765.12 |
| 1 | 30.0 | 356048.23 | 643951.77 | 3374965.83 |
| 1 | 40.0 | 340051.49 | 659948.51 | 3375189.15 |
| 1 | 50.0 | 324054.19 | 675945.80 | 3375436.09 |
| 2 | .0 | 308055.98 | 691944.02 | 3375702.63 |
| 2 | 10.0 | 292057.06 | 707942.94 | 3376004.79 |
| 2 | 20.0 | 276057.28 | 723942.72 | 3376323.56 |
| 2 | 30.0 | 260056.58 | 739943.42 | 3376665.95 |
| 2 | 40.0 | 244054.89 | 755945.11 | 3377031.94 |
| 2 | 50.0 | 228052.14 | 771947.86 | 3377421.55 |
| 3 | .0 | 212048.27 | 787951.73 | 3377834.77 |
| | | 30 | 40.0 | |
| | .0 | 500000.00 | 500000.00 | 3392473.54 |
| | 10.0 | 484033.57 | 515966.43 | 3392490.38 |
| | 20.0 | 468067.08 | 531932.92 | 3392525.91 |
| | 30.0 | 452100.46 | 547899.54 | 3392585.14 |
| | 40.0 | 436133.65 | 563866.35 | 3392668.05 |
| | 50.0 | 420166.57 | 579833.43 | 3392774.64 |
| 1 | .0 | 404199.16 | 595800.84 | 3392904.93 |
| 1 | 10.0 | 388231.37 | 611768.63 | 3393058.91 |
| 1 | 20.0 | 372263.11 | 627736.89 | 3393236.57 |
| 1 | 30.0 | 356294.34 | 643705.66 | 3393437.93 |
| 1 | 40.0 | 340324.97 | 659675.03 | 3393662.97 |
| 1 | 50.0 | 324354.96 | 675645.04 | 3393911.70 |
| 2 | .0 | 308384.22 | 691615.73 | 3394184.12 |
| 2 | 10.0 | 292412.70 | 707587.39 | 3394489.23 |
| 2 | 20.0 | 276440.33 | 723559.67 | 3394839.02 |
| 2 | 30.0 | 260467.05 | 739532.95 | 3395143.51 |
| 2 | 40.0 | 244492.79 | 755507.21 | 3395519.63 |
| 2 | 50.0 | 228517.49 | 771482.51 | 3395901.54 |
| 3 | .0 | 212541.07 | 787458.93 | 3396316.16 |

| Delta Long. | E(West of CM) | E(East of CM) | Northring |
|-------------|---------------|---------------|------------|
| Latitude | | | |
| 30 50.0 | | | |
| | .0 | 500000.00 | 500000.00 |
| | 10.0 | 484001.04 | 515938.96 |
| | 20.0 | 468122.02 | 531877.98 |
| | 30.0 | 452182.88 | 547817.12 |
| | 40.0 | 436243.53 | 563756.47 |
| | 50.0 | 420303.93 | 579696.07 |
| 1 | .0 | 404364.01 | 595635.99 |
| 1 | 10.0 | 388423.79 | 611576.30 |
| 1 | 20.0 | 372482.94 | 627517.66 |
| 1 | 30.0 | 356541.66 | 643458.34 |
| 1 | 40.0 | 340599.80 | 659400.20 |
| 1 | 50.0 | 324657.30 | 675342.79 |
| 2 | .0 | 308714.09 | 691285.91 |
| 2 | 10.0 | 292770.10 | 707229.90 |
| 2 | 20.0 | 276825.28 | 723174.72 |
| 2 | 30.0 | 260879.55 | 739120.45 |
| 2 | 40.0 | 244932.85 | 755067.15 |
| 2 | 50.0 | 228985.13 | 771014.87 |
| 3 | .0 | 213036.31 | 786963.69 |
| 31 .0 | | | |
| | .0 | 500000.00 | 500000.00 |
| | 10.0 | 484088.65 | 515911.35 |
| | 20.0 | 468177.23 | 531822.77 |
| | 30.0 | 452265.69 | 547734.31 |
| | 40.0 | 436353.96 | 563646.84 |
| | 50.0 | 420441.97 | 579558.03 |
| 1 | .0 | 404529.67 | 595470.33 |
| 1 | 10.0 | 388616.98 | 611383.02 |
| 1 | 20.0 | 372703.84 | 627296.16 |
| 1 | 30.0 | 356790.20 | 643209.80 |
| 1 | 40.0 | 340875.98 | 659124.02 |
| 1 | 50.0 | 324961.13 | 675038.87 |
| 2 | .0 | 309045.57 | 690954.42 |
| 2 | 10.0 | 293129.25 | 706870.75 |
| 2 | 20.0 | 277212.11 | 722787.89 |
| 2 | 30.0 | 261294.07 | 738705.93 |
| 2 | 40.0 | 245375.08 | 754624.92 |
| 2 | 50.0 | 229455.06 | 770544.94 |
| 3 | .0 | 213533.97 | 786466.93 |
| 31 10.0 | | | |
| | .0 | 500000.00 | 500000.00 |
| | 10.0 | 484116.39 | 515883.61 |
| | 20.0 | 468232.71 | 531767.29 |
| | 30.0 | 452348.91 | 547651.09 |
| | 40.0 | 436464.92 | 563535.08 |
| | 50.0 | 420580.68 | 579419.32 |
| 1 | .0 | 404696.13 | 595303.87 |
| 1 | 10.0 | 388811.20 | 611188.80 |
| 1 | 20.0 | 372925.82 | 627074.16 |
| 1 | 30.0 | 357039.95 | 642960.05 |
| 1 | 40.0 | 341153.51 | 658846.49 |
| 1 | 50.0 | 325266.44 | 674733.56 |
| 2 | .0 | 309378.67 | 690621.33 |
| 2 | 10.0 | 293490.16 | 706509.84 |
| 2 | 20.0 | 277600.32 | 722399.16 |
| 2 | 30.0 | 261710.61 | 738289.39 |
| 2 | 40.0 | 245819.45 | 754180.55 |
| 2 | 50.0 | 229927.29 | 770072.71 |
| 3 | .0 | 214034.06 | 785965.94 |
| | | | 3410948.03 |
| | | | 3410950.92 |
| | | | 3410995.56 |
| | | | 3411054.97 |
| | | | 3411138.14 |
| | | | 3411245.08 |
| | | | 3411375.78 |
| | | | 3411530.25 |
| | | | 3411798.47 |
| | | | 3411910.47 |
| | | | 3412136.22 |
| | | | 3412385.74 |
| | | | 3412659.03 |
| | | | 3412956.07 |
| | | | 3413276.88 |
| | | | 3413621.46 |
| | | | 3413900.80 |
| | | | 3414381.90 |
| | | | 3414797.77 |
| | | | 3422418.01 |
| | | | 3422429.93 |
| | | | 3422465.62 |
| | | | 3422525.28 |
| | | | 3422609.72 |
| | | | 3422715.99 |
| | | | 3422847.10 |
| | | | 3422992.05 |
| | | | 3423180.33 |
| | | | 3423383.46 |
| | | | 3423600.82 |
| | | | 3423860.22 |
| | | | 3424134.36 |
| | | | 3424432.33 |
| | | | 3424754.15 |
| | | | 3425090.80 |
| | | | 3425460.29 |
| | | | 3425862.62 |
| | | | 3426279.79 |
| | | | 3447888.47 |
| | | | 3447990.43 |
| | | | 3447936.30 |
| | | | 3447996.08 |
| | | | 3448079.77 |
| | | | 3448187.37 |
| | | | 3448319.86 |
| | | | 3448474.31 |
| | | | 3448653.65 |
| | | | 3448856.96 |
| | | | 3449084.06 |
| | | | 3449335.13 |
| | | | 3449610.11 |
| | | | 3449909.01 |
| | | | 3450231.82 |
| | | | 3450578.54 |
| | | | 3450942.17 |
| | | | 3451343.71 |
| | | | 3451762.17 |

| Delta Long. | E(West of CM) | E(East of CM) | Northing |
|-------------|---------------|---------------|-------------|
| Latitude | | | |
| 31 20.0 | | | |
| | 500000.00 | 500000.00 | 3466359.42 |
| .0 | 484144.26 | 515855.74 | 3466371.41 |
| 10.0 | 468288.46 | 531711.54 | 3466407.39 |
| 20.0 | 452432.54 | 547567.46 | 3466467.35 |
| 30.0 | 436576.43 | 563423.57 | 3466551.29 |
| 40.0 | 420720.07 | 579279.93 | 3466659.22 |
| 50.0 | 404863.40 | 595136.60 | 3466791.14 |
| 1 .0 | 389006.36 | 610993.64 | 3466947.94 |
| 1 10.0 | 373148.88 | 626851.12 | 3467126.92 |
| 1 20.0 | 357299.91 | 642709.99 | 3467339.79 |
| 1 30.0 | 341432.38 | 658567.62 | 3467558.64 |
| 1 40.0 | 325573.22 | 674426.78 | 3467810.47 |
| 1 50.0 | 309713.39 | 690286.61 | 3468086.30 |
| 2 .0 | 293852.81 | 706147.19 | 3468386.19 |
| 2 10.0 | 277991.42 | 722008.58 | 3468709.39 |
| 2 20.0 | 262129.17 | 737870.83 | 3469057.66 |
| 2 30.0 | 246265.98 | 753734.92 | 3469429.42 |
| 2 40.0 | 230401.80 | 769598.20 | 3469825.17 |
| 2 50.0 | 214536.57 | 785463.43 | 3470244.89 |
| 3 .0 | | | |
| 31 30.0 | | | |
| | 500000.00 | 500000.00 | 3484630.85 |
| .0 | 484172.27 | 515827.73 | 3484642.88 |
| 10.0 | 468344.48 | 531655.52 | 3484873.96 |
| 20.0 | 452516.56 | 547483.44 | 3484939.10 |
| 30.0 | 436688.47 | 563311.53 | 3485023.30 |
| 40.0 | 420860.12 | 579139.65 | 3485131.55 |
| 50.0 | 405031.48 | 594968.52 | 3485263.86 |
| 1 .0 | 389202.46 | 610797.54 | 3485420.23 |
| 1 10.0 | 373373.01 | 626626.92 | 3485600.65 |
| 1 20.0 | 357543.88 | 642456.92 | 3485805.13 |
| 1 30.0 | 341712.59 | 658287.41 | 3486033.67 |
| 1 40.0 | 325881.49 | 674118.31 | 3486286.26 |
| 1 50.0 | 310049.71 | 689950.29 | 3486562.90 |
| 2 .0 | 294217.21 | 705782.79 | 3486863.61 |
| 2 10.0 | 278383.90 | 721616.10 | 3487188.37 |
| 2 20.0 | 262549.74 | 737450.26 | 3487537.19 |
| 2 30.0 | 246714.66 | 753285.34 | 3487919.06 |
| 2 40.0 | 230878.59 | 769121.41 | 34883396.99 |
| 2 50.0 | 215041.49 | 784958.51 | 3488727.98 |
| 3 .0 | | | |
| 31 40.0 | | | |
| | 500000.00 | 500000.00 | 3503302.77 |
| .0 | 484200.41 | 515790.59 | 3503314.83 |
| 10.0 | 468400.76 | 531590.24 | 3503351.02 |
| 20.0 | 452600.99 | 547399.91 | 3503411.34 |
| 30.0 | 436801.94 | 563208.96 | 3503495.78 |
| 40.0 | 421000.85 | 579022.15 | 3503604.36 |
| 50.0 | 405200.36 | 594792.64 | 3503737.96 |
| 1 .0 | 389399.50 | 610609.50 | 3503893.89 |
| 1 10.0 | 373598.22 | 626401.78 | 3504074.84 |
| 1 20.0 | 357796.45 | 642203.55 | 3504279.93 |
| 1 30.0 | 341994.14 | 658005.86 | 3504509.14 |
| 1 40.0 | 326191.23 | 673808.77 | 3504762.48 |
| 1 50.0 | 310387.65 | 689612.35 | 3505039.94 |
| 2 .0 | 294583.34 | 705416.66 | 3505341.54 |
| 2 10.0 | 278778.25 | 721221.75 | 3505667.26 |
| 2 20.0 | 262972.32 | 737027.68 | 3506017.10 |
| 2 30.0 | 247165.48 | 752834.52 | 3506391.08 |
| 2 40.0 | 231357.67 | 768642.33 | 3506789.18 |
| 2 50.0 | 215548.83 | 784451.17 | 3507211.41 |
| 3 .0 | | | |

| Delta Long. | E(West of CM) | E(East of CM) | Northing | |
|-------------|---------------|---------------|-----------|------------|
| | Latitude | | | |
| | 31 | 50.0 | | |
| | .0 | 500000.00 | 500000.00 | 3521775.17 |
| | 10.0 | 484220.69 | 515771.31 | 3521737.27 |
| | 20.0 | 468457.32 | 531542.68 | 3521823.57 |
| | 30.0 | 452685.82 | 547314.18 | 3521884.06 |
| | 40.0 | 436914.15 | 563085.85 | 3521968.75 |
| | 50.0 | 421142.25 | 578857.73 | 3522077.64 |
| 1 | .0 | 405370.04 | 594629.06 | 3522210.73 |
| 1 | 10.0 | 389597.47 | 610402.53 | 3522368.02 |
| 1 | 20.0 | 373824.49 | 626175.51 | 3522549.50 |
| 1 | 30.0 | 358051.03 | 641948.97 | 3522755.18 |
| 1 | 40.0 | 342277.03 | 657722.97 | 3522985.06 |
| 1 | 50.0 | 326502.44 | 673497.56 | 3523239.14 |
| 1 | .0 | 310727.19 | 689272.01 | 3523517.41 |
| 2 | 10.0 | 294951.22 | 705048.78 | 3523819.88 |
| 2 | 20.0 | 279174.48 | 720825.52 | 3524146.55 |
| 2 | 30.0 | 263395.91 | 736603.00 | 3524497.42 |
| 2 | 40.0 | 247618.44 | 752381.56 | 3524872.48 |
| 2 | 50.0 | 231839.01 | 768160.99 | 3525271.75 |
| 3 | .0 | 216058.57 | 783941.43 | 3525695.21 |

| | | | | |
|---|------|-----------|-----------|------------|
| | | 32 | .0 | |
| | .0 | 500000.00 | 500000.00 | 3540248.07 |
| | 10.0 | 484257.10 | 515742.90 | 3540260.22 |
| | 20.0 | 468514.14 | 531485.06 | 3540296.60 |
| | 30.0 | 452771.06 | 547228.94 | 3540357.27 |
| | 40.0 | 437027.89 | 562972.20 | 3540442.20 |
| | 50.0 | 421284.31 | 578715.62 | 3540551.41 |
| 1 | .0 | 405540.52 | 594459.48 | 3540684.38 |
| 1 | 10.0 | 389796.38 | 610203.62 | 3540842.61 |
| 1 | 20.0 | 374051.83 | 625948.17 | 3541024.62 |
| 1 | 30.0 | 358306.81 | 641693.12 | 3541230.89 |
| 1 | 40.0 | 342561.26 | 657438.74 | 3541461.43 |
| 1 | 50.0 | 326815.12 | 673184.88 | 3541716.23 |
| 2 | .0 | 311068.33 | 688931.67 | 3541995.31 |
| 2 | 10.0 | 295320.64 | 704679.16 | 3542298.65 |
| 2 | 20.0 | 279572.58 | 720427.42 | 3542626.26 |
| 2 | 30.0 | 263823.50 | 736176.50 | 3542978.13 |
| 2 | 40.0 | 248073.53 | 751926.47 | 3543354.27 |
| 2 | 50.0 | 232322.63 | 767677.37 | 3543754.68 |
| 3 | .0 | 216570.72 | 783429.28 | 3544179.36 |

| | | | | | |
|---|------|-----------|-----------|------------|--|
| | | 32 | 10.0 | | |
| | .0 | 500000.00 | 500000.00 | 3558721.45 | |
| | 10.0 | 484285.64 | 515714.36 | 3558733.62 | |
| | 20.0 | 468571.22 | 531423.78 | 3558779.13 | |
| | 30.0 | 452856.69 | 547143.31 | 3558830.97 | |
| | 40.0 | 437141.98 | 562853.02 | 3558916.14 | |
| | 50.0 | 421427.04 | 578572.06 | 3559025.65 | |
| 1 | .0 | 405711.81 | 594238.19 | 3559159.50 | |
| 1 | 10.0 | 389973.23 | 610000.77 | 3559317.68 | |
| 1 | 20.0 | 374250.24 | 625719.76 | 3559500.20 | |
| 1 | 30.0 | 358563.79 | 641436.21 | 3559707.06 | |
| 1 | 40.0 | 342846.82 | 657153.18 | 3559936.25 | |
| 1 | 50.0 | 327129.26 | 672870.74 | 3560193.78 | |
| 2 | .0 | 311411.07 | 688588.93 | 3560473.64 | |
| 2 | 10.0 | 295692.18 | 704307.82 | 3560777.34 | |
| 2 | 20.0 | 279972.54 | 720027.46 | 3561106.37 | |
| 2 | 30.0 | 264252.09 | 735747.91 | 3561459.24 | |
| 2 | 40.0 | 248530.76 | 751469.24 | 3561836.45 | |
| 2 | 50.0 | 232808.51 | 767191.49 | 3562237.99 | |
| 3 | .0 | 217085.27 | 782914.73 | 3562663.87 | |

| Delta Long. | E(West of CM) | E(East of CM) | Northring |
|-------------|---------------|---------------|------------|
| Latitude | | | |
| 32 20.0 | | | |
| | 500000.00 | 500000.00 | 3577195.33 |
| 10.0 | 484314.32 | 515685.68 | 3577207.54 |
| 20.0 | 463628.57 | 531371.43 | 3577244.14 |
| 30.0 | 452942.72 | 547957.28 | 3577305.15 |
| 40.0 | 437256.69 | 562743.31 | 3577390.56 |
| 50.0 | 421570.43 | 573429.57 | 3577500.38 |
| 1 0.0 | 405883.89 | 594116.11 | 3577634.60 |
| 1 10.0 | 390197.00 | 609803.00 | 3577793.23 |
| 1 20.0 | 374509.71 | 625490.29 | 3577976.25 |
| 1 30.0 | 358821.97 | 641178.03 | 3578183.69 |
| 1 40.0 | 343133.71 | 656866.29 | 3578415.52 |
| 1 50.0 | 327444.87 | 672555.13 | 3578671.76 |
| 2 0.0 | 311755.41 | 688244.59 | 3578952.40 |
| 2 10.0 | 296065.26 | 703934.74 | 3579257.45 |
| 2 20.0 | 280374.37 | 719625.63 | 3579586.90 |
| 2 30.0 | 264682.68 | 735317.32 | 3579940.76 |
| 2 40.0 | 248990.12 | 751009.88 | 3580319.01 |
| 2 50.0 | 233296.56 | 766703.44 | 3580721.68 |
| 3 0.0 | 217602.22 | 782397.78 | 3581148.74 |
| 32 30.0 | | | |
| | 500000.00 | 500000.00 | 3595669.71 |
| 10.0 | 484343.12 | 515656.88 | 3595681.94 |
| 20.0 | 463665.19 | 531313.81 | 3595718.65 |
| 30.0 | 453029.15 | 546970.85 | 3595779.83 |
| 40.0 | 437371.93 | 562628.07 | 3595865.47 |
| 50.0 | 421714.49 | 578285.51 | 3595975.59 |
| 1 0.0 | 406056.77 | 593943.23 | 3596119.18 |
| 1 10.0 | 390398.71 | 609601.29 | 3596269.24 |
| 1 20.0 | 374740.25 | 625259.75 | 3596452.77 |
| 1 30.0 | 359081.34 | 640918.66 | 3596660.77 |
| 1 40.0 | 343421.93 | 656578.07 | 3596893.25 |
| 1 50.0 | 327761.95 | 672238.05 | 3597150.19 |
| 2 0.0 | 312101.34 | 687898.66 | 3597431.60 |
| 2 10.0 | 296440.07 | 703559.93 | 3597737.49 |
| 2 20.0 | 280778.06 | 719221.94 | 3598067.84 |
| 2 30.0 | 265115.25 | 734884.75 | 3598422.67 |
| 2 40.0 | 249451.61 | 750548.39 | 3598801.97 |
| 2 50.0 | 233787.06 | 766212.94 | 3599205.73 |
| 3 0.0 | 218121.55 | 781878.45 | 3599633.97 |
| 32 40.0 | | | |
| | 500000.00 | 500000.00 | 3614144.58 |
| 10.0 | 484372.06 | 515627.94 | 3614156.84 |
| 20.0 | 463744.07 | 531255.93 | 3614193.65 |
| 30.0 | 453115.97 | 546884.03 | 3614254.99 |
| 40.0 | 437487.79 | 562512.30 | 3614340.87 |
| 50.0 | 421859.21 | 578140.79 | 3614451.29 |
| 1 0.0 | 406230.44 | 593769.56 | 3614586.24 |
| 1 10.0 | 390601.34 | 609398.66 | 3614745.73 |
| 1 20.0 | 374971.35 | 625028.15 | 3614929.76 |
| 1 30.0 | 359341.91 | 640658.09 | 3615138.32 |
| 1 40.0 | 343711.47 | 656288.53 | 3615371.42 |
| 1 50.0 | 328080.46 | 671919.52 | 3615629.06 |
| 2 0.0 | 312448.87 | 687551.13 | 3615911.24 |
| 2 10.0 | 296816.60 | 703183.40 | 3616217.95 |
| 2 20.0 | 281183.60 | 718816.40 | 3616549.20 |
| 2 30.0 | 265549.82 | 734459.18 | 3616904.98 |
| 2 40.0 | 249915.21 | 750084.79 | 3617285.31 |
| 2 50.0 | 234279.72 | 765720.28 | 3617690.17 |
| 3 0.0 | 218643.27 | 781356.73 | 3618119.56 |

| Delta Long. | E(West of CM) | E(East of CM) | Northring |
|-------------|---------------|---------------|------------|
| Latitude | | | |
| 32 50.0 | | | |
| | 500000.00 | 500000.00 | 3632619.94 |
| 10.0 | 484401.14 | 515598.86 | 3632632.24 |
| 20.0 | 466802.22 | 531197.78 | 3632669.15 |
| 30.0 | 453203.20 | 546796.80 | 3632750.65 |
| 40.0 | 437604.01 | 562395.99 | 3632816.76 |
| 50.0 | 422004.60 | 577995.40 | 3632927.47 |
| 1 0.0 | 406404.91 | 593595.09 | 3633062.78 |
| 1 10.0 | 390804.90 | 609195.10 | 3633222.79 |
| 1 20.0 | 375204.59 | 624795.50 | 3633407.22 |
| 1 30.0 | 359603.67 | 640396.33 | 3633616.34 |
| 1 40.0 | 344002.34 | 655997.66 | 3633850.06 |
| 1 50.0 | 328400.46 | 671599.54 | 3634108.38 |
| 2 0.0 | 312797.98 | 687202.02 | 3634391.31 |
| 2 10.0 | 297194.84 | 702805.16 | 3634698.84 |
| 2 20.0 | 281592.99 | 718409.01 | 3635030.97 |
| 2 30.0 | 265996.38 | 734013.62 | 3635387.70 |
| 2 40.0 | 250390.94 | 749619.06 | 3635769.04 |
| 2 50.0 | 234774.62 | 765225.38 | 3636174.98 |
| 3 0.0 | 219167.38 | 780832.62 | 3636605.52 |
| 33 .0 | | | |
| | 500000.00 | 500000.00 | 3651025.81 |
| 10.0 | 484430.34 | 515569.66 | 3651108.14 |
| 20.0 | 466860.63 | 531139.37 | 3651145.14 |
| 30.0 | 453290.82 | 546709.16 | 3651206.81 |
| 40.0 | 437720.84 | 562279.16 | 3651293.14 |
| 50.0 | 422150.64 | 577849.36 | 3651404.14 |
| 1 0.0 | 406580.17 | 593419.83 | 3651539.81 |
| 1 10.0 | 391009.38 | 608990.62 | 3651700.14 |
| 1 20.0 | 375438.22 | 624561.78 | 3651885.15 |
| 1 30.0 | 359866.61 | 640133.39 | 3652094.81 |
| 1 40.0 | 344294.53 | 655705.47 | 3652329.15 |
| 1 50.0 | 328721.90 | 671278.19 | 3652588.15 |
| 2 0.0 | 313148.68 | 686851.32 | 3652871.82 |
| 2 10.0 | 297574.81 | 702425.19 | 3653180.16 |
| 2 20.0 | 282000.24 | 717999.76 | 3653513.16 |
| 2 30.0 | 266424.91 | 733575.09 | 3653879.83 |
| 2 40.0 | 250848.78 | 749151.22 | 3654253.16 |
| 2 50.0 | 235271.78 | 764728.22 | 3654660.17 |
| 3 0.0 | 219693.86 | 780306.14 | 3655091.84 |
| 33 10.0 | | | |
| | 500000.00 | 500000.00 | 3669572.17 |
| 10.0 | 484459.68 | 515549.32 | 3669584.54 |
| 20.0 | 468919.31 | 531099.69 | 3669621.63 |
| 30.0 | 453378.83 | 546621.17 | 3669683.46 |
| 40.0 | 437838.19 | 562161.81 | 3669779.01 |
| 50.0 | 422297.34 | 577702.66 | 3669881.39 |
| 1 0.0 | 406756.23 | 593243.77 | 3670017.32 |
| 1 10.0 | 391214.79 | 608785.21 | 3670178.97 |
| 1 20.0 | 375672.98 | 624327.02 | 3670363.55 |
| 1 30.0 | 360130.75 | 639869.25 | 3670573.76 |
| 1 40.0 | 344588.04 | 655411.86 | 3670808.70 |
| 1 50.0 | 329044.79 | 670955.21 | 3671068.37 |
| 2 0.0 | 313500.96 | 686499.64 | 3671352.77 |
| 2 10.0 | 297956.49 | 702043.51 | 3671661.90 |
| 2 20.0 | 282411.33 | 717588.67 | 3671995.76 |
| 2 30.0 | 266865.43 | 733134.57 | 3672354.36 |
| 2 40.0 | 251318.71 | 748681.27 | 3672737.68 |
| 2 50.0 | 235771.17 | 764228.83 | 3673145.74 |
| 3 0.0 | 220222.72 | 779777.28 | 3673578.52 |

| Delta Long. | E(West of CM) | E(East of CM) | Northing |
|-------------|---------------|---------------|------------|
| Latitude | | | |
| 33 20.0 | | | |
| | 500000.00 | 500000.00 | 3688042.33 |
| 10.0 | 484482.15 | 515517.85 | 3688061.43 |
| 20.0 | 468978.25 | 531021.75 | 3688080.62 |
| 30.0 | 453467.24 | 546532.76 | 3688160.61 |
| 40.0 | 437956.08 | 562043.92 | 3688247.38 |
| 50.0 | 422444.71 | 577555.29 | 3688358.95 |
| 1 .0 | 406933.07 | 593066.93 | 3688495.32 |
| 1 10.0 | 391421.12 | 608578.88 | 3688656.47 |
| 1 20.0 | 375908.80 | 624091.20 | 3688842.42 |
| 1 30.0 | 360396.07 | 639603.93 | 3689053.17 |
| 1 40.0 | 344882.86 | 655117.14 | 3689283.71 |
| 1 50.0 | 329369.13 | 670639.87 | 3689549.04 |
| 2 .0 | 313854.82 | 686145.18 | 3689834.16 |
| 2 10.0 | 298339.39 | 701660.11 | 3690144.08 |
| 2 20.0 | 282824.27 | 717175.73 | 3690478.79 |
| 2 30.0 | 267307.92 | 732692.98 | 3690838.29 |
| 2 40.0 | 251799.78 | 748209.22 | 3691222.59 |
| 2 50.0 | 236272.81 | 763727.19 | 3691631.68 |
| 3 .0 | 220753.95 | 779246.05 | 3692065.57 |
| 33 30.0 | | | |
| | 500000.00 | 500000.00 | 3706526.40 |
| 10.0 | 484516.75 | 515483.25 | 3706538.33 |
| 20.0 | 469037.45 | 530962.55 | 3706576.11 |
| 30.0 | 453556.05 | 546443.95 | 3706638.25 |
| 40.0 | 438074.49 | 561925.51 | 3706725.25 |
| 50.0 | 422592.73 | 577407.27 | 3706837.09 |
| 1 .0 | 407110.70 | 592889.30 | 3706973.09 |
| 1 10.0 | 391628.37 | 608371.63 | 3707135.36 |
| 1 20.0 | 376145.66 | 623854.32 | 3707321.78 |
| 1 30.0 | 360662.57 | 639337.43 | 3707533.95 |
| 1 40.0 | 345179.00 | 654821.99 | 3707769.17 |
| 1 50.0 | 329694.91 | 670305.09 | 3708030.16 |
| 2 .0 | 314210.26 | 685789.74 | 3708315.99 |
| 2 10.0 | 298724.99 | 701275.91 | 3708626.69 |
| 2 20.0 | 283239.04 | 716760.96 | 3708962.23 |
| 2 30.0 | 267752.38 | 732247.62 | 3709322.64 |
| 2 40.0 | 252264.94 | 747735.06 | 3709707.90 |
| 2 50.0 | 236776.68 | 763223.32 | 3710118.01 |
| 3 .0 | 221287.54 | 778712.46 | 3710552.98 |
| 33 40.0 | | | |
| | 500000.00 | 500000.00 | 3725004.27 |
| 10.0 | 484548.40 | 515451.60 | 3725016.73 |
| 20.0 | 469096.92 | 530903.08 | 3725054.10 |
| 30.0 | 453645.25 | 546354.75 | 3725116.40 |
| 40.0 | 438193.43 | 561806.57 | 3725203.60 |
| 50.0 | 422741.40 | 577258.60 | 3725315.73 |
| 1 .0 | 407289.12 | 592710.88 | 3725452.77 |
| 1 10.0 | 391836.54 | 608163.46 | 3725614.73 |
| 1 20.0 | 376383.60 | 623616.40 | 3725801.60 |
| 1 30.0 | 360930.25 | 639069.75 | 3726013.39 |
| 1 40.0 | 345476.45 | 654523.55 | 3726250.19 |
| 1 50.0 | 330022.14 | 669977.86 | 3726511.73 |
| 2 .0 | 314567.27 | 685432.73 | 3726798.27 |
| 2 10.0 | 299111.79 | 700888.21 | 3727109.73 |
| 2 20.0 | 283655.66 | 716344.34 | 3727446.10 |
| 2 30.0 | 268198.81 | 731801.19 | 3727807.39 |
| 2 40.0 | 252741.20 | 747258.80 | 3728193.60 |
| 2 50.0 | 237282.77 | 762717.23 | 3728604.72 |
| 3 .0 | 221823.49 | 778176.51 | 3729040.77 |

| Delta Long. | E(West of CM) | E(East of CM) | Northring |
|-------------|---------------|---------------|------------|
| Latitude | | | |
| 33 50.0 | | | |
| .0 | 500000.00 | 500000.00 | 3743482.65 |
| 10.0 | 464578.35 | 515421.65 | 3743495.13 |
| 20.0 | 469156.64 | 530843.36 | 3743532.60 |
| 30.0 | 453734.84 | 546265.16 | 3743595.04 |
| 40.0 | 438312.89 | 561687.11 | 3743682.46 |
| 50.0 | 422890.73 | 577109.27 | 3743794.86 |
| 1 .0 | 407468.33 | 592531.67 | 3743932.13 |
| 1 10.0 | 392045.62 | 607954.38 | 3744094.83 |
| 1 20.0 | 376622.57 | 623377.43 | 3744281.91 |
| 1 30.0 | 361199.12 | 638800.88 | 3744494.21 |
| 1 40.0 | 345775.21 | 654224.79 | 3744731.49 |
| 1 50.0 | 330350.81 | 669649.19 | 3744993.75 |
| 2 .0 | 314925.86 | 685074.14 | 3745280.99 |
| 2 10.0 | 299500.30 | 700499.70 | 3745593.20 |
| 2 20.0 | 284074.10 | 715925.90 | 3745930.39 |
| 2 30.0 | 268647.20 | 731352.80 | 3746292.56 |
| 2 40.0 | 253219.55 | 746780.45 | 3746679.70 |
| 2 50.0 | 237791.10 | 762208.90 | 3747091.82 |
| 3 .0 | 222361.80 | 777638.20 | 3747528.92 |
| 34 .0 | | | |
| .0 | 500000.00 | 500000.00 | 3761961.53 |
| 10.0 | 464608.34 | 515391.66 | 3761974.04 |
| 20.0 | 469216.63 | 530783.37 | 3762011.60 |
| 30.0 | 453824.82 | 546175.18 | 3762074.10 |
| 40.0 | 438432.87 | 561567.13 | 3762161.82 |
| 50.0 | 423040.72 | 576959.28 | 3762274.48 |
| 1 .0 | 407648.32 | 592351.68 | 3762412.18 |
| 1 10.0 | 392255.62 | 607744.38 | 3762574.92 |
| 1 20.0 | 376862.59 | 623137.41 | 3762762.69 |
| 1 30.0 | 361469.15 | 638530.85 | 3762975.50 |
| 1 40.0 | 346075.28 | 653924.72 | 3763213.35 |
| 1 50.0 | 330680.91 | 669319.09 | 3763476.23 |
| 2 .0 | 315286.01 | 684713.99 | 3763764.15 |
| 2 10.0 | 299890.51 | 700109.49 | 3764077.11 |
| 2 20.0 | 284494.38 | 715505.62 | 3764415.19 |
| 2 30.0 | 269097.55 | 730902.45 | 3764778.13 |
| 2 40.0 | 253699.99 | 746300.61 | 3765166.19 |
| 2 50.0 | 238301.64 | 761698.36 | 3765579.39 |
| 3 .0 | 222902.46 | 777097.54 | 3766017.44 |
| 34 10.0 | | | |
| .0 | 500000.00 | 500000.00 | 3780440.91 |
| 10.0 | 464638.46 | 515361.54 | 3780453.46 |
| 20.0 | 469276.88 | 530723.12 | 3780491.10 |
| 30.0 | 453915.20 | 546084.80 | 3780553.84 |
| 40.0 | 438553.37 | 561446.63 | 3780641.48 |
| 50.0 | 423191.35 | 576808.65 | 3780754.69 |
| 1 .0 | 407829.09 | 592170.91 | 3780892.63 |
| 1 10.0 | 392466.54 | 607533.46 | 3781055.74 |
| 1 20.0 | 377103.64 | 622896.36 | 3781243.96 |
| 1 30.0 | 361740.37 | 638259.63 | 3781457.27 |
| 1 40.0 | 346376.65 | 653623.35 | 3781695.67 |
| 1 50.0 | 331012.45 | 668987.55 | 3781959.17 |
| 2 .0 | 315647.72 | 684352.28 | 3782247.76 |
| 2 10.0 | 300282.41 | 699717.59 | 3782561.45 |
| 2 20.0 | 284916.48 | 715083.52 | 3782900.24 |
| 2 30.0 | 269549.86 | 730450.14 | 3783264.12 |
| 2 40.0 | 254182.52 | 745817.48 | 3783653.90 |
| 2 50.0 | 238814.40 | 761185.60 | 3784067.16 |
| 3 .0 | 223445.47 | 776554.53 | 3784506.32 |

| Delta Long. | E(West of CM) | E(East of CM) | Northring |
|-------------|---------------|---------------|------------|
| Latitude | | | |
| 34 20.0 | | | |
| | 500000.00 | 500000.00 | 3798920.01 |
| 10.0 | 484668.72 | 515331.28 | 3798933.39 |
| 20.0 | 469337.39 | 530662.61 | 3798971.12 |
| 30.0 | 454005.96 | 545994.04 | 3799034.90 |
| 40.0 | 438674.40 | 561325.60 | 3799122.03 |
| 50.0 | 423342.64 | 576657.36 | 3799235.22 |
| 1 0.0 | 408010.64 | 591989.36 | 3799373.56 |
| 1 10.0 | 392678.36 | 607321.64 | 3799537.96 |
| 1 20.0 | 377345.73 | 622654.27 | 3799725.70 |
| 1 30.0 | 362012.75 | 637987.25 | 3799939.50 |
| 1 40.0 | 346679.33 | 653320.67 | 3800178.46 |
| 1 50.0 | 331345.43 | 668654.57 | 3800442.56 |
| 2 0.0 | 316011.00 | 683989.00 | 3800731.82 |
| 2 10.0 | 300676.01 | 699323.99 | 3801046.23 |
| 2 20.0 | 285340.40 | 714659.60 | 3801385.80 |
| 2 30.0 | 270004.12 | 729995.88 | 3801750.51 |
| 2 40.0 | 254667.13 | 745332.67 | 3802140.39 |
| 2 50.0 | 239329.38 | 760670.62 | 3802555.41 |
| 3 0.0 | 223990.82 | 776009.18 | 3802995.59 |
| 34 30.0 | | | |
| | 500000.00 | 500000.00 | 3817401.22 |
| 10.0 | 484669.10 | 515330.90 | 3817413.82 |
| 20.0 | 469338.16 | 530660.84 | 3817451.64 |
| 30.0 | 454007.12 | 545992.88 | 3817514.66 |
| 40.0 | 438675.94 | 561204.06 | 3817602.89 |
| 50.0 | 423344.57 | 576505.43 | 3817716.34 |
| 1 0.0 | 408012.97 | 591807.03 | 3817854.99 |
| 1 10.0 | 392681.09 | 607108.91 | 3818018.86 |
| 1 20.0 | 377348.89 | 622411.11 | 3818207.93 |
| 1 30.0 | 362016.30 | 637713.79 | 3818422.22 |
| 1 40.0 | 346683.30 | 653016.79 | 3818661.71 |
| 1 50.0 | 331349.83 | 668320.17 | 3818926.41 |
| 2 0.0 | 316017.64 | 683624.16 | 3819216.33 |
| 2 10.0 | 300685.30 | 698928.79 | 3819531.45 |
| 2 20.0 | 285352.14 | 714233.86 | 3819871.76 |
| 2 30.0 | 270019.33 | 729539.67 | 3820237.33 |
| 2 40.0 | 254686.56 | 744846.18 | 3820628.08 |
| 2 50.0 | 239353.82 | 760153.44 | 3821044.94 |
| 3 0.0 | 224020.51 | 775461.49 | 3821485.22 |
| 34 40.0 | | | |
| | 500000.00 | 500000.00 | 3835882.13 |
| 10.0 | 484722.62 | 515279.38 | 3835894.76 |
| 20.0 | 469459.19 | 530540.81 | 3835932.66 |
| 30.0 | 454188.66 | 545811.34 | 3835995.83 |
| 40.0 | 438918.00 | 561082.80 | 3836084.26 |
| 50.0 | 423647.16 | 576352.84 | 3836197.96 |
| 1 0.0 | 408376.09 | 591623.91 | 3836336.92 |
| 1 10.0 | 393104.74 | 606895.26 | 3836501.15 |
| 1 20.0 | 377833.06 | 622166.94 | 3836690.64 |
| 1 30.0 | 362561.02 | 637438.98 | 3836905.40 |
| 1 40.0 | 347289.57 | 652711.43 | 3837145.43 |
| 1 50.0 | 332015.66 | 667984.34 | 3837410.72 |
| 2 0.0 | 316742.24 | 683257.76 | 3837701.28 |
| 2 10.0 | 301468.27 | 698531.73 | 3838017.11 |
| 2 20.0 | 286193.70 | 713806.39 | 3838358.20 |
| 2 30.0 | 270918.49 | 729081.51 | 3838724.56 |
| 2 40.0 | 255642.59 | 744357.41 | 3839116.18 |
| 2 50.0 | 240365.95 | 759634.95 | 3839533.97 |
| 3 0.0 | 225088.53 | 774911.47 | 3839975.22 |

| Delta Long. | E(West of CM) | E(East of CM) | Northring |
|-------------|---------------|---------------|------------|
| Latitude | | | |
| 34 50.0 | | | |
| | 500000.00 | 500000.00 | 3854363.56 |
| 10.0 | 484769.26 | 515230.74 | 3854376.22 |
| 20.0 | 469520.47 | 530479.53 | 3854414.20 |
| 30.0 | 454280.60 | 545719.40 | 3854477.50 |
| 40.0 | 439040.59 | 560959.41 | 3854566.13 |
| 50.0 | 423800.39 | 576199.61 | 3854680.07 |
| 1 0.0 | 408559.97 | 591440.03 | 3854819.34 |
| 1 10.0 | 393319.29 | 606680.72 | 3854983.93 |
| 1 20.0 | 378078.28 | 621921.72 | 3855173.84 |
| 1 30.0 | 362836.91 | 637163.09 | 3855389.07 |
| 1 40.0 | 347595.14 | 652404.86 | 3855629.62 |
| 1 50.0 | 332352.91 | 667647.09 | 3855895.49 |
| 2 0.0 | 317110.19 | 682889.81 | 3856186.59 |
| 2 10.0 | 301866.92 | 698132.98 | 3856503.20 |
| 2 20.0 | 286623.07 | 713375.93 | 3856845.04 |
| 2 30.0 | 271378.58 | 728621.42 | 3857212.20 |
| 2 40.0 | 256133.42 | 743866.58 | 3857604.60 |
| 2 50.0 | 240887.54 | 759112.46 | 3858022.48 |
| 3 0.0 | 225640.89 | 774359.11 | 3858465.60 |
| 35 .0 | | | |
| | 500000.00 | 500000.00 | 3872845.59 |
| 10.0 | 484791.03 | 515208.97 | 3872858.19 |
| 20.0 | 469562.02 | 530417.98 | 3872896.25 |
| 30.0 | 454372.92 | 545627.98 | 3872959.60 |
| 40.0 | 439163.68 | 560836.32 | 3873048.51 |
| 50.0 | 423954.27 | 576045.73 | 3873162.70 |
| 1 0.0 | 408744.64 | 591255.36 | 3873302.26 |
| 1 10.0 | 393534.74 | 606465.26 | 3873467.20 |
| 1 20.0 | 378324.52 | 621675.48 | 3873657.52 |
| 1 30.0 | 363113.96 | 636886.04 | 3873873.21 |
| 1 40.0 | 347902.99 | 652097.91 | 3874114.28 |
| 1 50.0 | 332691.58 | 667309.42 | 3874380.73 |
| 2 0.0 | 317479.68 | 682520.32 | 3874672.55 |
| 2 10.0 | 302267.25 | 697732.75 | 3874989.74 |
| 2 20.0 | 287054.25 | 712945.75 | 3875332.31 |
| 2 30.0 | 271840.62 | 728159.30 | 3875709.26 |
| 2 40.0 | 256626.33 | 743373.27 | 3876123.58 |
| 2 50.0 | 241411.32 | 758588.48 | 3876572.28 |
| 3 0.0 | 226195.57 | 773804.43 | 3877056.35 |

APPENDIX B

UNIVERSAL TRANSVERSE MERCATOR SYSTEM

The UTM locational system was developed by the United States and its allies shortly after World War II. It is almost identical to the Soviet Unified Reference System used in the USSR and eastern Europe. The west-east zones of UTM are based on the International Map of the World established in international agreements in 1909, 1913, and 1962.

Basically, the world is divided into 60 zones, each 6° longitude in width beginning at 180° longitude and numbered consecutively from west to east. Thus, the conterminous United States lies in zones 10 through 19 as shown in Figure B-1. A rectilinear grid is superimposed on each zone with a 500 000 m false easting along the Central Meridian and a 0 m northing at the equator for the Northern Hemisphere [1].

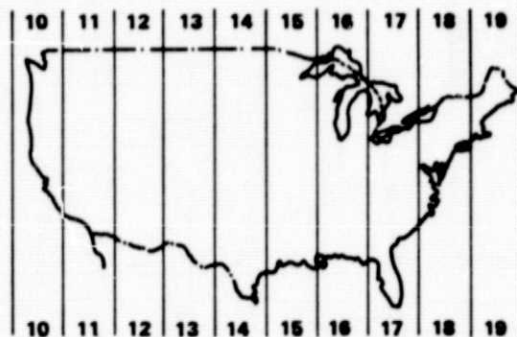
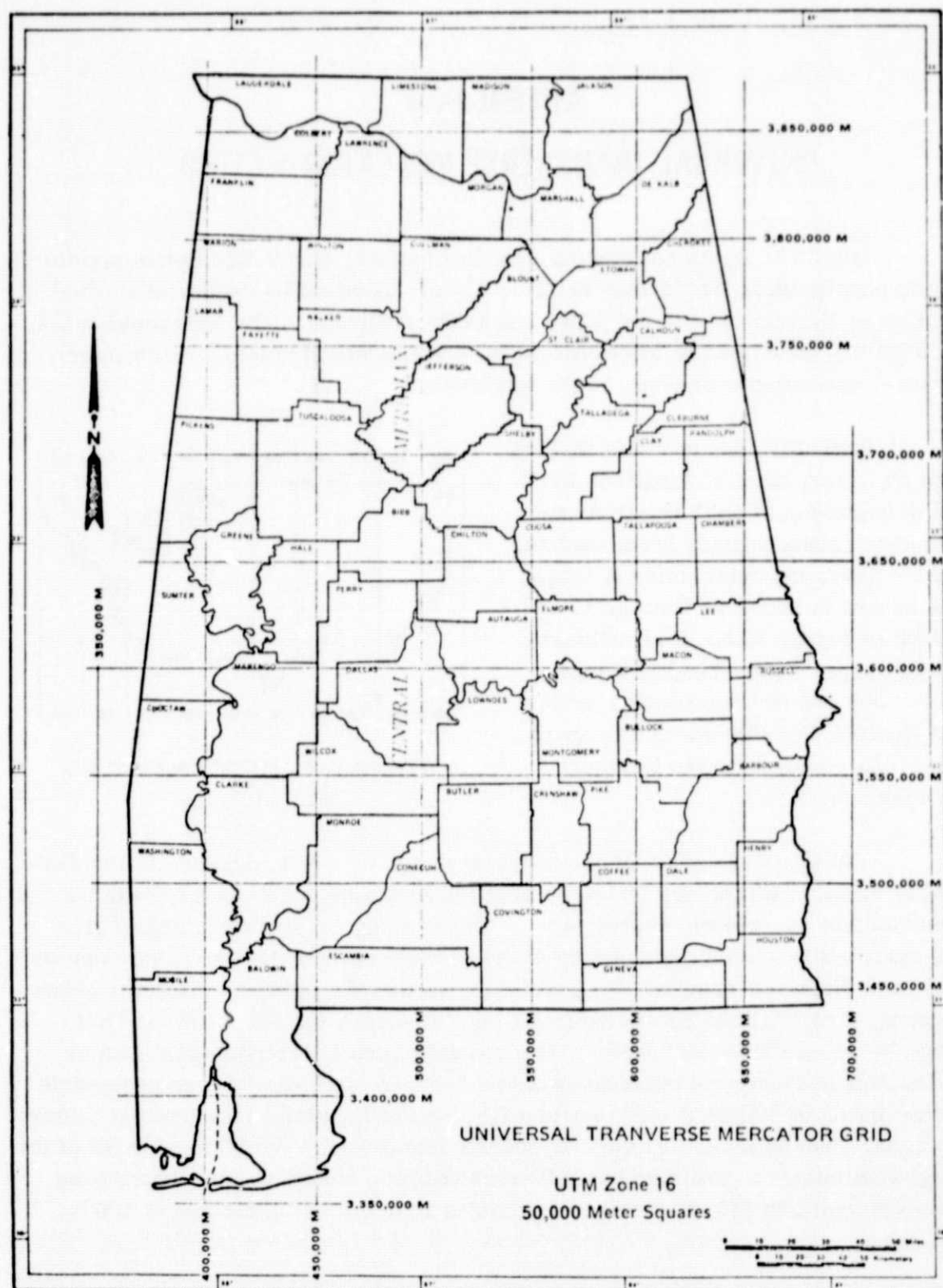


Figure B-1. UTM zones of the United States.

Alabama is in zone 16 in its entirety, and 87° west longitude is the Central Meridian with the 500 000 m easting for that zone. Any location can be described by two metric coordinates in this system. It is customary to give the easting first, then the northing — "read right up." It is also customary to omit any digits not required for precision, so that the location of a town within a county map might be identified in full as "Tuskegee 623000 3588000," but could be abbreviated as "23 88." Full identification of the southwest corner of the Macon County Courthouse would be "623066 3588068," but an acceptable abbreviation to "23066 88068" would still give the location to the nearest meter. An area, such as a hectare cell, is usually identified by the UTM address of its southwest corner. The hectare cell containing the Macon County Courthouse would be cell 230 880, for example (keeping in mind that a hectare is 100 by 100 m).

In addition to publications by Colvocoresses, an excellent discussion of UTM was published by the Alabama Development Office [2]. Figure B-2 is reproduced here from Reference 2.



REFERENCES

1. Colvocoresses, A. P.: A Unified Plane Co-ordinate Reference System. World Cartography, Vol. IX, United Nations, NY, 1969, pp. 9-65.
2. Stevenson, Walter B., Jr.: Planner's Mapping and Classification Guide. Alabama Development Office Report No. ALA-ADP-X996, 1020-02, Montgomery, Ala., Revised June 1973.

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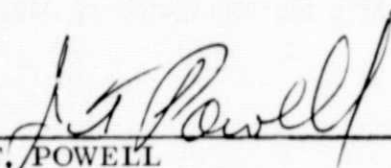
APPROVAL

PROCEDURE FOR LOCATING 10 km UTM GRID ON ALABAMA COUNTY GENERAL HIGHWAY MAPS

By Charles T. N. Paludan

The information in this report has been reviewed for security classification. Review of any information concerning Department of Defense or Atomic Energy Commission programs has been made by the MSFC Security Classification Officer. This report, in its entirety, has been determined to be unclassified.

This document has also been reviewed and approved for technical accuracy.



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